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MEMORANDUM
November 6, 1985

To: Jon Neel

From: John Bernhardt

Subject: Pendleton Woolen Mills Wastewater Treatment Plant Class II Inspection, September 25-26 and November 13-14, 1984

INTRODUCTION

Pendleton Woolen Mills is located at Washougal, a small residential community near the Columbia River in Clark County, Washington (Figure 1). The mill manufactures finished sportswear, blankets, fabrics, and other woolen goods. Wastewaters are routed to a secondary treatment plant located on-site which consists of three unit processes; a ballast pond, aeration basin, and clarifier (Figure 2). The activated sludge, extended aeration treatment process is used. Effluent is discharged to the Columbia River while sludge wastes are spray-irrigated onto nearby pasture lands.

The Class II inspection was conducted by John Bernhardt and Marc Heffner, WDOE Water Quality Investigations Section; Gary Bailey, WDOE Southwest Regional Office; and Don Wienk, environmental coordinator with Pendleton Woolen Mills. The inspection was designed to meet the following objectives:

1. Compare inspection data to NPDES permit limits.

2. Characterize plant operation and treatment efficiency.

3. Review laboratory procedures and sampling protocol.

4. Conduct brief receiving water investigation.

This report documents results of the inspection and makes recommendations concerning treatment plant operation and maintenance based on these findings.

METHODS

The September 25-26, 1984, survey addressed all four objectives of the inspection. The purpose of the November 13-14, 1984, effort was to collect follow-up information on priority pollutants. It was necessary to perform the priority pollutant sampling later because of scheduling considerations at the WDOE analytical laboratory.

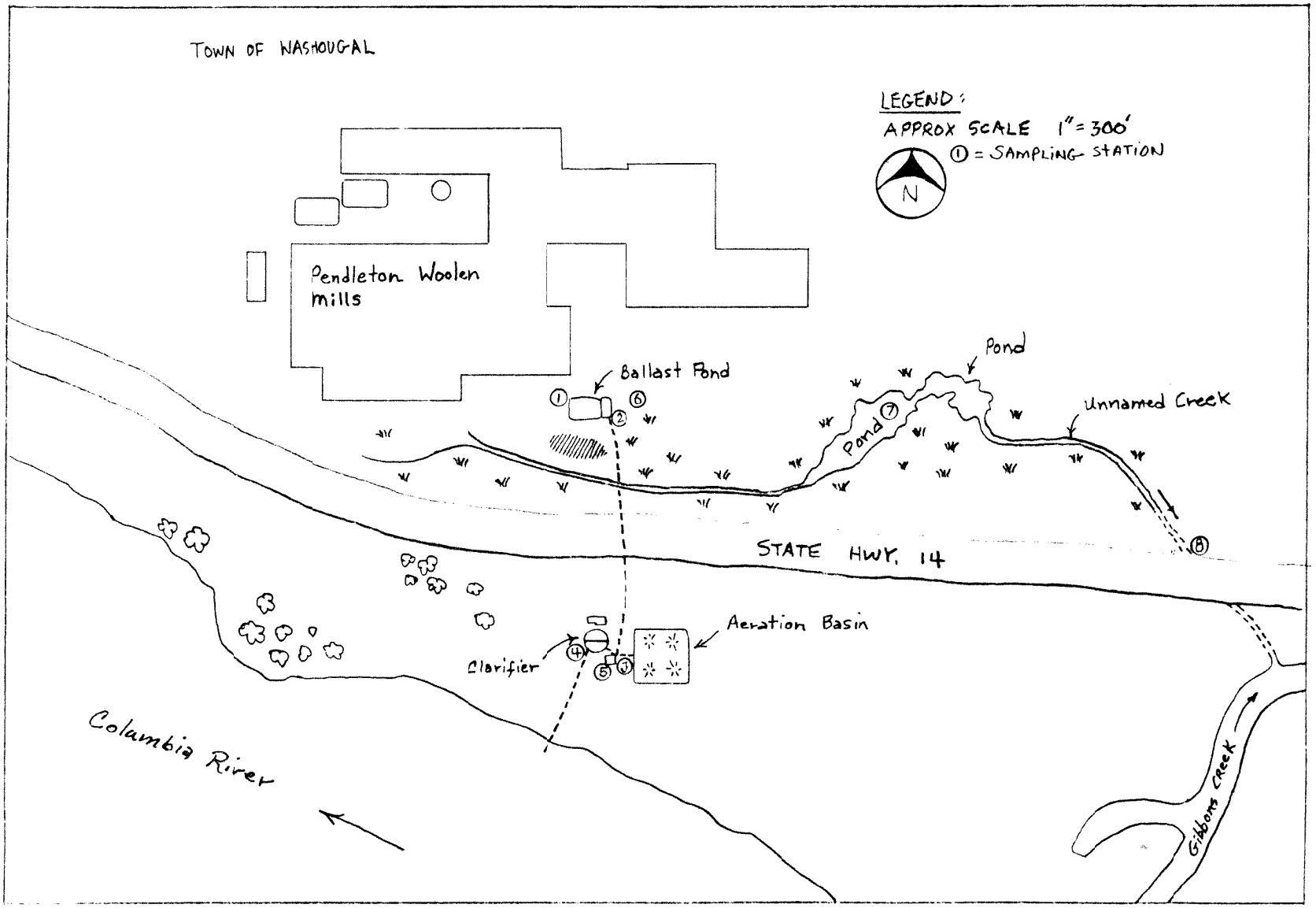

Figure 1. Map showing Pendleton Woolen Mills and Wastewater Treatment Plant, Washougal, Washington.

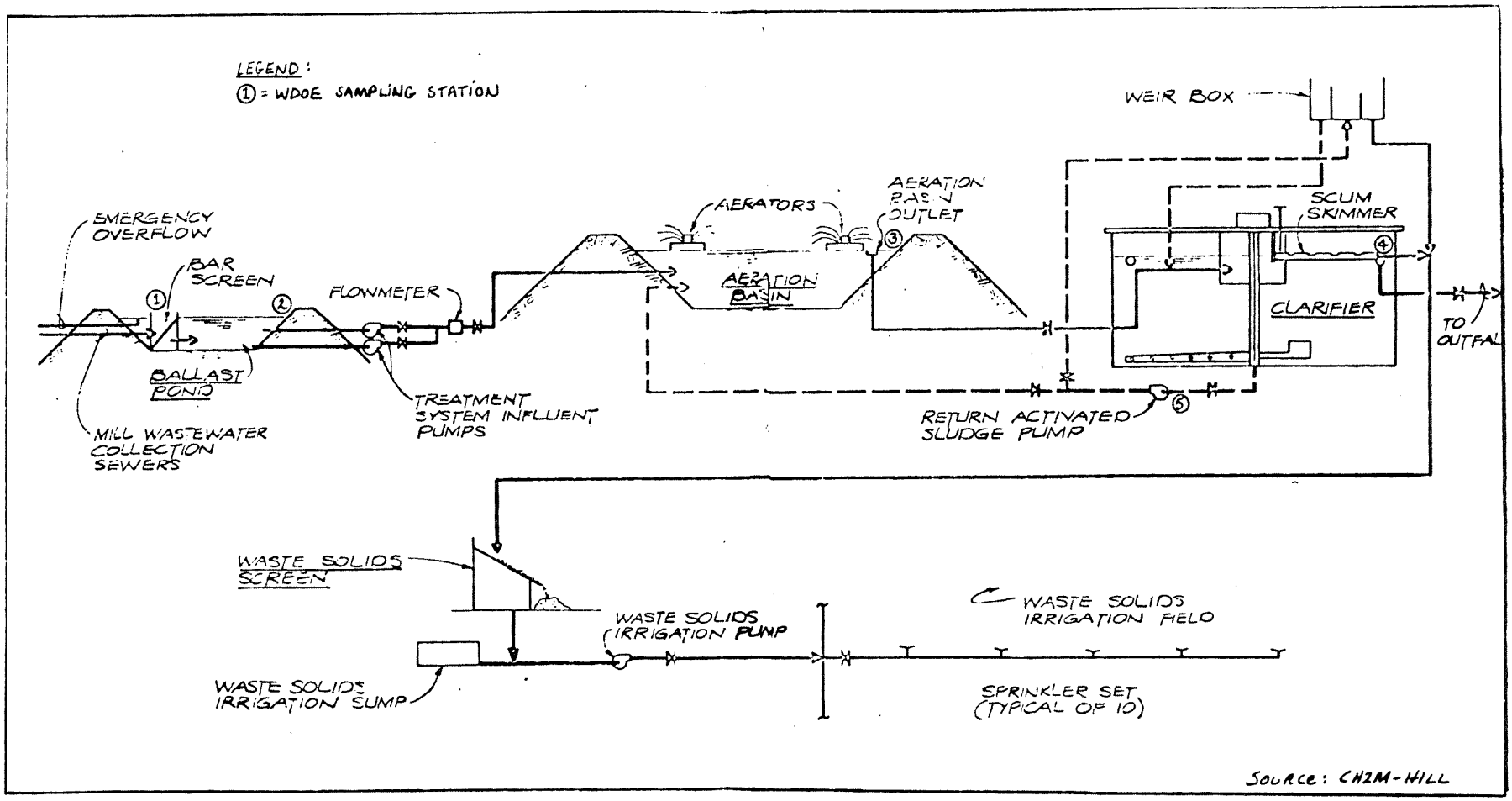

Figure 2. Schematic of Pendleton Woolen Mills Treatment System.

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For the September 25-26 survey, sampling was performed at five treatment plant sites (Figures 1 and 2). Twenty-four-hour composite samples were collected at three locations; the ballast pond inlet, ballast pond outlet, and final effluent. The compositors were set to collect 200 ml of sample every 30 minutes. Grab samples were periodically collected at all five sites. Ninety-six-hour bioassays using juvenile salmonids were performed on samples of the return activated sludge and final effluent. The bioassay samples were hand composites (four subsamples) collected during the 24-hour period that the compositors were operating. The sampling schedule and parametric coverage are summarized in Table 1.

There are no access points at the treatment plant where flow could be measured directly, using available methods. All flow data were obtained from the plant's totalizer.

Pendleton Woolen Mills performs the required NPDES tests at its analytical laboratory located on-site. For the laboratory procedures review, Don Wienk was interviewed using the standard WDOE questionnaire (Appendix I). Analytical procedures were observed as tests were performed. Twenty-four-hour composite samples were split to compare WDOE and Pendleton test results.

Receiving water samples were collected at two stations during the September 25-26 survey (Figure 1). One station was on the small unnamed creek which receives runoff from the ballast pond and mill area. The second station was in a swampy area near the ballast pond where a spill occurred during the inspection. This incident was investigated by the WDOE Southwest Regional Office (Bailey, 1984).

Sampling was performed at three stations during the November 13-14 toxics survey; the return activated sludge, clarifier effluent, and the upper of two ponds formed by the unnamed creek which receives drainage from the mill grounds (Figure 1). A 24-hour composite sample was collected from the clarifier effluent. At the pond, four sediment samples were collected with a petite Ponar grab sampler. A subsample of surface sediments (top 2 cm.) was obtained from each grab and composited into a single sample for analysis. Laboratory analyses included EPA priority pollutant organics and metals. A 96-hour bioassay was performed on the final effluent. The EP-TOX test for metals and 96-hour bioassay were performed on the sludge.

RESULTS

The composite- and grab-sampling data collected during the inspection are given in Tables 2, 3, and 4. These data provide an overview of the survey findings and serve as a reference for the discussions that follow.

NPDES Permit Compliance

The analytical results for the NPDES permit parameters are given in Table 5. Noteworthy findings include:

Table 1. Sampling schedule for Class II facility inspection performed at Pendleton Woolen Mills wastewater treatment plant; September 25-26 and November 13-14, 1984.

Sample	Station No.	Date	Time	Field Analyses								Laboratory Analyses																
				pH	Cond.	Temp.	Diss. Oxygen	Flow	Sludge Depth	Chromium (+6)	Sulfide	pH	Turb.	Cond.	COD	BOD	BOD (sol.)	Nutr. (5)	Solids (4)	Alk.	T. Hardness	Color	Fecal Coliform	Phenolics	Oil & Grease	Metals	96-hr. Bioassay	EP TOX	Pr. Pollut. (sed)	Pr. Pollut. (wtr)
Grab Samples																													
Ballast Pond Influent	1	9/25	1244	X	X	X						X	X	X	X			X	X	X	X	X							
		9/25	1714	X	X	X																							
		9/26	0845	X	X	X																							
Ballast Pond Effluent	2	9/25	1211	X	X	X						X	X	X	X			X	X	X	X	X							
		9/25	1720	X	X	X																							
		9/26	0900	X	X	X			X																				
Aeration Basin Effluent	3	9/25	1443	X	X	X	X		X			X	X	X	X			X	X	X	X	X							
		9/26	0950	X	X	X	X					X	X	X	X			X	X	X	X	X							
Clarifier (final) Effluent	4	9/25	1042	X	X	X		X		X	X	X	X	X	X			X	X	X	X	X	X	X	X		X		
		9/25	1740	X	X	X		X	X																				
		9/26	0940	X	X	X		X		X	X	X	X	X	X			X	X	X	X	X	X	X	X	X			
		11/14	1039					X																		X			X
Return Activated Sludge	5	9/25	1500																X										
		9/26	1135																X						X	X			
		11/14	1039																							X	X	X	
Swamp near Ballast Pond	6	9/25	1200									X	X	X	X	X		X	X	X	X	X		X	X	X			
Unnamed Creek (Pond) 800' blw.	7	11/14	1039																									X	
Unnamed Creek 1400' below	8	9/25	1650	X	X	X	X	X				X	X	X	X			X	X	X	X	X	X	X	X	X			
		9/26	1027	X	X	X	X	X		X	X	X	X	X	X			X	X	X	X	X	X	X	X	X			
Composite Samples																													
Ballast Pond Influent	1	9/25	1244																										
		9/26	1200	X	X	X						X	X	X	X	X		X	X	X	X	X	X			X			
Ballast Pond Effluent	2	9/25	1211																										
		9/26	1200	X	X	X						X	X	X	X	X		X	X	X	X	X	X						
Clarifier (final) Effluent	4	9/25	1042					X																					
		9/26	1130	X	X	X		X				X	X	X	X	X	X	X	X	X	X	X	X			X			
		11/13	1200					X																					
		11/13	1438					X																					
		11/14	1039					X																					X

Table 2. Composite sample analytical results, WDOE Class II inspection performed at Pendleton Woolen Mills during September 25 and 26, 1984. All values in mg/L unless otherwise noted.

Parameter	Ballast Pond Influent (Station 1)	Ballast Pond Effluent (Station 2)	Clarifier (final) Effluent (Station 4)	Effluent Load[1] (lbs/day)
Flow (MGD)	--[2]	--	0.85	--
pH (S.U.)	7.0	7.1	7.4	--
Turbidity (NTU)	170	140	65	--
Sp. Conductivity (umhos/cm)	694	786	732	--
COD	270	320	240	1,700
BOD_5	210	68	<10	<71
Soluble BOD_5	--	--	<10	<71
Nitrate-N	1.1	1.0	<0.05	<0.35
Nitrite-N	<0.05	<0.05	<0.05	<0.35
Ammonia-N	6.8	6.4	0.05	0.35
O-phosphate-P	0.65	0.50	2.5	17.7
T-phosphate-P	0.70	5.0	3.5	24.8
Total Solids	680	690	600	4,250
Total Nonvolatile Solids	420	460	460	3,250
Total Suspended Solids	80	57	59	418
Total Nonvolatile Suspended Solids	10	1	6	42.5
Alkalinity as $CaCO_3$	92	100	83	588
Total Hardness as $CaCO_3$	44	52	44	312
Color (units)	560	480	180	--

[1] (0.85 MGD)(mg/L)/0.12 = lbs/day

[2] -- = analysis not performed

Table 3. Grab sample analytical results, WDOE Class II inspection performed at Pendleton Woolen Mills during September 25 and 26, 1984. All values mg/L unless otherwise noted.

Station Name and Number	Ballast Pond Influent (Station 1)				Ballast Pond Effluent (Station 2)				Aeration Basin Effluent (Station 3)		Clarifier (final) Effluent (Station 4)				Return Activated Sludge (Station 5)		Swamp Near Ballast Pond (Station 6)	Unnamed Creek 1400 ft. blw Ballast Pond (Station 8)	
Date	9/25	9/25	9/26	9/26†	9/25	9/25	9/26	9/26†	9/25	9/26	9/25	9/25	9/26	9/26†	9/25	9/26	9/25	9/25	9/26
Time	1244	1714	0845	1200	1211	1720	0900	1200	1443	0950	1042	1740	0940	1130	1500	1135	1200	1650	1027
Field Parameters																			
Flow (cfs)	--	--	--	--	--	--	--	--	--	--	--	--	--	1.32††	--	--	--	0.17	0.21
pH (S.U.)	6.8	6.7	7.5	6.9	5.8	6.9	7.5	7.0	6.9	7.1	6.9	7.0	7.1	7.3	--	--	--	6.9	7.2
Sp. Cond. (umhos/cm)	200	215	>1000	670	920	825	235	750	700	700	732	725	710	730	--	--	--	365	380
Temp. (°C)	21.1	22.1	17.7	--	21.2	26.8	27.5	--	19.1	19.3	17.1	19.3	19.1	--	--	--	--	17.0	15.6
Diss. Oxygen	--	--	--	--	--	--	--	--	0.2	0.6	--	0.1	--	--	--	--	--	0.1	0.0
Hex. Chromium	--	--	--	--	--	--	--	--	--	--	0.1	--	<0.1	--	--	--	--	--	ND
Sulfide	--	--	--	--	--	--	--	--	--	--	ND	--	<0.1	--	--	--	--	--	0.2
Laboratory Analyses																			
pH (S.U.)	7.3	--	7.0	--	5.8	--	7.1	--	6.9	7.0	7.0	--	7.4	--	--	--	10.3	6.9	7.0
Turb. (NTU)	130	--	170	--	200	--	140	--	1500	1700	50	--	65	--	--	--	540	19	16
Sp. Cond. (umhos/cm)	202	--	694	--	874	--	786	--	747	726	735	--	732	--	--	--	543	396	394
COD	480	--	270	--	520	--	320	--	5200	4600	170	--	240	--	--	--	10,000	75	93
BOD_5	--	--	210	--	--	--	68	--	--	--	--	--	<10	--	--	--	220	--	--
Sol BOD_5	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	--	--	--	--
Nitrate-N	0.60	--	1.1	--	0.70	--	1.0	--	<0.05	<0.01	<0.05	--	<0.05	--	--	--	0.05	<0.02	0.05
Nitrite-N	<0.10	--	<0.05	--	<0.05	--	<0.05	--	<0.05	<0.01	<0.05	--	<0.05	--	--	--	0.02	<0.02	<0.02
Ammonia-N	0.90	--	6.8	--	2.0	--	6.4	--	0.35	0.40	0.05	--	0.05	--	--	--	0.05	4.0	4.3
O-PO_4-P	0.30	--	0.65	--	0.90	--	0.50	--	5.6	4.0	5.0	--	2.5	--	--	--	0.10	4.0	4.1
T-PO_4-P	0.45	--	0.70	--	18.0	--	5.0	--	7.8	28.0	6.0	--	3.5	--	--	--	2.6	5.4	5.3
T. Solids	350	--	680	--	730	--	690	--	3100	3400	600	--	600	--	16,000	21,000	2800	290	310
TNVS	150	--	420	--	590	--	460	--	890	880	480	--	460	--	2800	3400	600	240	230
TSS	50	--	80	--	20	--	57	--	2600	2600	50	--	59	--	14,000	19,000	1900	37	10
TNVSS	1	--	10	--	3	--	1	--	400	430	5	--	6	--	2200	3000	180	34	10
Alk. as $CaCO_3$	93	--	92	--	48	--	100	--	120	110	88	--	83	--	--	--	590	82	82
T. Hardness as $CaCO_3$	35	--	44	--	40	--	52	--	56	32	48	--	44	--	--	--	40	60	48
Color (units)	310	--	560	--	520	--	480	--	130	250	120	--	180	--	--	--	2400	150	160
Rec. Phenolics as Phenol	--	--	--	--	--	--	--	--	--	--	0.049	--	0.05	--	--	--	0.05	0.026	0.01
Rec. Oil & Grease	--	--	--	--	--	--	--	--	--	--	7	--	8	--	--	--	3900	5	5
Fecal Coliform (col/100 mL)	--	--	--	--	--	--	--	--	--	--	980	--	3000*	--	--	--	--	2700	1300

† - Collected from compositor.
†† = 0.85 MGD.
ND = None detected.
* = Estimate.
-- = Analysis not performed

Table 4. Metals detected in WDOE samples collected at Pendleton Woolen Mills during September 25-26, 1984.

Parameter	Station 1 Ballast Pond Influent 24-hr. Composite (ug/L)	Station 4 Clarifier (final) Effluent 24-hr. Composite (ug/L)	Station 4 Clarifier (final) Effluent Grab (ug/L)	Station 5 Return Activated Sludge Grab (ug/Kg)	Station 5 Return Activated Sludge EP-TOX* (mg/L)	Dangerous Waste Criteria** (mg/L)	Station 6 Swamp near Ballast Pond Grab (ug/L)	Station 8 Unnamed Creek 1,400 ft. blw. Ballast Pond Grab (ug/L)	Station 8 Unnamed Creek 1,400 ft. blw. Ballast Pond Grab (ug/L)
copper	70	/60/	/68/	2,100	***	--	/192/	/41/	/92/
zinc	458	/450/	/433/	21,100	***	--	/1,054/	/177/	/167/
nickel	<1	27	24	343	***	--	40	<1	<1
chromium	792	/549/	/521/	40,000	0.386	5-500	29	/227/	/198/
cadmium	<0.2	<0.2	<0.2	28.1	0.003	1-100	/0.8/	<0.2	<0.2
lead	5	/4/	/4/	865	0.049	5-500	/169/	<1	<1
mercury	--	--	--	--	0.00023	0.2-20	--	--	--
arsenic	--	--	--	--	0.033	5-500	--	--	--
selenium	--	--	--	--	0.0035	1-100	--	--	--
barium	--	--	--	--	0.680	100-10,000	--	--	--
silver	--	--	--	--	<0.0001	5-500	--	--	--
% solids	--	--	--	2.0	--	--	--	--	--

*Collected November 13-14, 1984.
**WDOE, 1984
***Not an EP-TOX metal

/ / = Exceeds water quality criteria.

EPA receiving water criteria (based on 44 mg/L T. hardness as $CaCO_3$):

Parameter	24-hour	Never-To-Exceed	Chronic
copper	5.6	10.2	--
zinc	47	163	--
nickel	51.2	988	--
chromium (+3)	--	1933	44
cadmium	0.01	1.28	--
lead	0.56	63.2	--

Table 5. Comparison of WDOE inspection data to NPDES permit limits, Pendleton Woolen Mills, September 25-26, 1984 (all values are lbs/day).

	NPDES Permit Limit		Class II Inspection Results	
Parameter	Daily Average	Daily Maximum	Final Effluent 24-hr. Composite	Final Effluent Grab Samples
BOD5	185	370	<71	--; <71
COD	1,345	2,690	/1,700/	1,204; /1,700/
TSS	290	580	/418/	/354/; /418/
Total chromium	1.1	2.3	--	/3.69/; /3.69/
Phenol	1.1	2.3	--	0.35; 0.35
Sulfide	2.3	4.6	--	ND; <0.71
pH	Range: 6.0 - 9.0		--	6.9; 7.0; 7.1
Temperature	21°C	--	--	17.1; 19.3; 19.1
Flow (MGD)	1.00	1.25	0.85	

NOTE:

lbs/day = (MGD)(mg/L)/0.12.

/ / = Exceeds daily average or maximum permit limit.

ND = None detected.

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1. Biochemical oxygen demand (BOD_5) fell well below the daily average and maximum permit limits.
2. Chemical oxygen demand (COD) and total suspended solids (TSS) exceeded the daily average, but met the maximum permit limit.
3. Total chromium exceeded the daily average and maximum permit limit.
4. The requirements were being met for the remaining five permit parameters; phenol, sulfide, pH, temperature, and flow.

Overall, the plant operation appeared to be marginal with respect to NPDES permit compliance with total chromium being well above the limit.

Plant Operation and Treatment Efficiency

General

Wastewaters generated by the mill originate primarily from two major sources; the dye house and finishing house. The wastewaters contain a wide array of chemical constituents, ranging from natural impurities in wool (dirt, wax, grease, etc.) to chemicals used for processing the wool. An inventory performed during the inspection indicated more than 40 chemical compounds are used at the mill (Table 6).

Table 6. List of chemicals observed at Pendleton Woolen Mills, Washougal; September 1985.

Name	Name
Formic Acid	Various Dyes
Aminogen W.R.L.	Palegal TX-512
Jum Leveler	Albegal BMD
Neovadine AN (200%)	Nyanthrol
Amaquest pH	Merse RTD
Synoquest Hk	JPS Leveler 104
Tetra Sodium Pyrophosphate	Tinegal WRL
Ammonium Sulfate	Ammonium Hydroxide
Ferrous Sulfate	Tanalon Jet Special
Sodium Bicarbonate	Sodium Acetate
Albegal B	Trisodium Phosphate
Pluronic F-68LF	T.U.D.
H.A.S.	Hydrogen Peroxide
Chrome	Acedic Acid
Amawet DF	Sulfuric Acid
Fibermate LR 31	Triethylene Glycol
Oxalic Acid	Aminogen R
Basophen M	Carbonic Acid
Chromium Floride	Soda Ash
Mount Hood Soap	Sodium Sulfate

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An indication of the general character of the wastewaters discharged from the dye house and finishing house was obtained from Don Wienk. Estimated influent concentrations for selected NPDES permit parameters are given in Table 7.

Table 7. Estimated influent concentrations for selected NPDES permit parameters at Pendleton Woolen Mills.

Parameter	Dye House	Finishing House
Flow (MGD)	0.4	0.6
BOD (mg/L)	50-100	150-250
COD (mg/L)	200-300	400-500
TSS (mg/L)	10	20
pH (S.U.)	4.0-4.5	7.5-8.0
T. chromium (mg/L)	0.38	0

Flow through the treatment plant fluxuates widely during weekdays because dyeing and finishing is done in batches. Flow drops to nil on weekends when production is shut down. The dye house discharges mainly spent dye water and rinse water which varies in composition depending on the type of dye and process used. This also is true of the finishing house, but the chemicals used are different for the most part. Wastewaters from this operation originate from washing, carbonizing, scouring, and other finishing processes. Soap wastes are a major component of wastewaters discharged from the finishing house.

Flow Measurements

Flow through the treatment plant averaged about 0.85 MGD during the inspection, based on totalizer readings observed at the pump house (Table 8).

Table 8. Flow measurements obtained during WDOE Class II inspection, Pendleton Woolen Mills; September 25-26, 1984.

Date	Time	Totalizer Reading	Difference	Flow Rate for Time Increment (MGD)*
9/25	1042	19479533		
9/26	1536	19481465	1932	0.95
9/26	1143	19488396	6931	0.83

*Average flow rate during the composite sampling period = 0.85 million

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Ballast Pond

Field measurements indicated the pond is earthen with the following dimensions: 70'x35'x3.5' deep (Table 9).

Table 9. Size of unit processes, Pendleton Woolen Mills; September 25-26, 1984.

Unit	Length (feet)	Width (feet)	Depth (feet)	Volume (ft^3)	Volume (gallons)
Ballast Pond	70	37	2.5	6,475	48,433
Aeration Basin	120	120	9.3	133,920	1,000,000*
Clarifier	--	40	10	12,570	94,024

*As reported by Don Weink, plant operator.

The bottom was covered with a 1-foot layer of compact sludge, resulting in an effective depth of 2.5 feet. Detention time was estimated at 1.3 hours. The ballast pond was not operating efficiently at the time of the inspection. Circulation appeared to be very poor with little mixing occurring. Slug loads of influent wastes were observed short-circuiting through the system, at times forming vertical density gradients.

The water quality sampling data collected from the ballast pond influent and effluent streams (Tables 2, 3 and 4) were highly variable. Some parameters like BOD were lower than would be expected at the outlet, while others like COD and TSS increased. The variability appeared to exist between the two stations and over time at both stations. This is an expected result when slug loading occurs and mixing is not complete. Under such conditions, there is the problem that any monitoring data collected may not accurately reflect the character of the influent stream. This problem can be minimized by setting the compositor to sample at frequent intervals, possibly 5 or 10 minutes. Sampling at the outlet of the ballast pond is preferred if the intent is to use the data collected for process control.

Aeration Basin

The aeration basin measures approximately 120 feet square by 9 feet deep, with a capacity of about 1,000,000 gallons (Table 9). Four 20 HP surface units provide aeration. For the three measures of organic matter included in the NPDES permit, removal efficiencies (includes clarifier) at the time of the inspection are given in Table 10.

Table 10. Organic matter removal efficiencies - Pendleton Woolen Mills, September 1984.

Parameter	Percent Removed	Expected Removal Efficiencies*
BOD	>95, >85	70 - 94+
COD	11, 30	50 - 70
TSS	29, 26	85 - 95

*Source: EPA, 1978.

The plant appeared to efficiently removing BOD but not COD or TSS. As previously noted, the effluent COD and TSS concentrations violated the NPDES limits during the inspection (Table 5). Whether or not the BOD removal was as efficient as the data imply is not entirely certain since the effluent contained a toxic component (see Bioassay Results and Metals data). However, toxicity did not appear to significantly affect the BOD test based on a review of the WDOE laboratory bench sheets. If the BOD value of the more dilute sample is always greater than predicted, this may indicate that there is some toxic material in the wastewater (EPA, 1977). This process, known as "toxic slide," was not observed even though the parent effluent sample was toxic to some degree.

Situations where BOD removal is adequate but COD removal is not may result from solids loss in the final effluent. Such a condition also may indicate a soluble or colloidal non-biodegradable substance is present in the water (EPA, 1978). Soluble COD tests should be run to determine which is the case. If the latter is true, an effort should be made to determine whether any such materials are being used at the mill, and biodegradable process chemicals substituted where possible. Pre-treatment, chemical removal, and filtration are other considerations.

Design parameters for facilities treating textile industry wastewaters using the extended aeration process (ibid) are compared with the inspection measurements in Table 11.

Comparisons of textile mill design recommendations with the Pendleton WTP loadings calculated using data collected during the inspection should be viewed with some caution because of the previously noted variability with the influent monitoring data. Under such circumstances it is very difficult to make reliable judgments concerning the status of this operation. Some noteworthy observations include:

1. Organic loading appeared to be within the acceptable range based on the F/M ratio, but this could not be determined with certainty because of variability of the influent BOD analytical results.

Table 11. Extended aeration design parameters for textile industry wastewaters compared with measurements made during WDOE Pendleton Woolen Mills inspection; September 25-26, 1984.

Parameter	Design Criteria[1/]	Inspection Measurements
Aeration Basin		
Detention Time	72 to 120 hours	30.9 hours
Depth	10 ft. min.; 15 ft. max.	9.3 feet
Recirculation of Activated Sludge[2/]	100 percent	100 percent
Organic Load (F/M)	0.04 and 0.1 lb. BOD_5/ day/lb. MLVSS	0.03 and 0.08[3/]
MLVSS	2500 to 3500 mg/L	2200 mg/L
Dissolved Oxygen in Mixed Liquor	2 mg/L	0.2, 0.6 mg/L
Clarifier		
Overflow rate	300 gpd/ft^2	676 gpd/ft^2
Detention Time	2 to 4 hours	2.7 hours
Depth	8 to 12 feet	10 feet

1/ Based on 1978 EPA manual, "Environmental Pollution Control Textile Processing Industry," EPA-625//-78-002.

2/ Treatment Plant was building up solids inventory at time of inspection.

3/ Based on 24-hour composite BOD results of 210 mg/L and 68 mg/L for the ballast pond influent and effluent, respectively.

2. Detention time is considerably less than the three or four days recommended for extended aeration basins serving wool-finishing operations.

3. MLVSS concentrations were lower than generally recommended.

4. Depth of the aeration basin is at the low end of the scale.

5. Dissolved oxygen levels in the aeration basin were low.

Observations 1, 2, and 3 seem contradictory since to maintain the F/M ratio within the acceptable range (Observation 1), detention time (Observation 2) and MLVSS concentrations (Observation 3) would not be possible.

The operator noted that all of the sludge had been recycled for several months without reaching recommended MLVSS concentrations in the aeration basin (Weink, personal communication), suggesting that the system is underloaded. A pinpoint floc problem (see Clarifier section) also suggests that the sludge age may be too high. Both of these observations indicate that a reduced MLVSS concentration may be appropriate, in contrast to the design manual recommendation that the MLVSS concentration be greater. The need for operational or design modifications cannot be fairly evaluated with the small amount of data collected during the short time span of the Class II inspection. The effects of slug loading, toxicity, and overall variations in influent quality on the treatment system should be quantified through an intensive, long-term monitoring effort. Then, appropriate modifications (operational and physical) should be made to the treatment system.

The grab sampling data collected from the aeration basin (Table 3) were reasonably consistent. An exception was total phosphate which increased from 7.8 mg/L on September 25 to 28 mg/L the next day. A concentration of 18 mg/L was observed in the ballast pond on September 25, indicating a slug load passed through, possibly soap or detergent wastes.

Clarifier

The clarifier has a 40-foot diameter and is 10 feet deep (Table 9). The detention time (2.7 hours) met the design criteria for textile mills, but the overflow rate exceeded the criteria (Table 11). The settling period required for extended aeration clarifiers is relatively long because the solids resulting from this process typically settle slowly. A high overflow rate can contribute to solids loss.

The clarifier was experiencing what appeared to be a pinpoint floc problem at the time of the inspection. This normally occurs when the aeration basin is underloaded and old sludge builds up in the system (Hill, 1984). Increased sludge wasting is recommended in these cases.

Memo to Jon Neel
Pendleton Woolen Mills Wastewater Treatment Plant Class II Inspection,
September 25-26 and November 13-14, 1984

Special Investigations

Receiving Waters

The treatment plant discharges to the Columbia River (Figure 1). A receiving water survey was not performed in the vicinity of the outfall. Access would have been difficult and the environmental impact was anticipated to be minimal because of the volume of water available for dilution.

Samples were collected from the unnamed creek which receives runoff from the mill grounds. The creek was flowing at about 0.2 cfs at the time of the survey. The virtual absence of dissolved oxygen, hydrogen sulfide odor in bottom sediments (released when disturbed), and elevated concentrations of ammonia and other parameters indicated the creek was experiencing significant adverse impacts (Table 3). The creek also is probably affected by organic pollutants as indicated by the sediment toxics data collected from the pond located upstream.

Priority Pollutants

The final effluent contained low levels of organic priority pollutants at the time of the November 13-14, 1984, survey (Table 12). 4-methylphenol, the pesticides DDT and gamma-BHC (Lindane), and PCB 1260 were detected in the return activated sludge. Twenty-nine organic compounds were detected in sediments collected from the pond on the creek which drains the mill grounds (Table 12). There are no established criteria for freshwater sediments, but the relatively high concentrations and large number of different compounds observed are cause for concern.

Metals concentrations were generally high in the clarifier effluent, with zinc, copper, chromium, and lead exceeding EPA receiving water criteria (Table 4). Zinc was especially high. The return activated sludge fell within the acceptable range for the eight EP-TOX metals. This does not necessarily mean that the metals are "acceptable," just that the sludge is not a dangerous waste. Metals concentrations were high enough to inhibit carbonaceous removal (Table 13). Nitrification inhibition was a possible concern (mainly due to zinc), but problems were not observed with the monitoring data.

Table 13. Threshold concentrations of pollutants inhibitory to the activated sludge process (from MOP/8, 1977).

Pollutant	Concentration (ug/L) Carbonaceous Removal	Concentration (ug/L) Nitrification	Observed Ballast Pond Influent	Concentration (mg/L) Final Effluent Comp.	Concentration (mg/L) Final Effluent Grab
copper	1,000	5 - 500	/70/	/60/	/68/
zinc	80 - 10,000	80 - 500	/458/	/450/	/433/
nickel	1,000 - 2,500	250	<1	27	24
chromium (+6)	1,000 - 10,000	250	--	--	--
chromium (+3)	50,000	--	792	549	521
cadmium	10,000 - 100,000	--	<0.2	<0.2	<0.2
lead	100	500	5	4	4

/ / = Observed concentration falls within inhibitory range.

Table 12. Organic compounds detected in WDOE samples collected at Pendleton Woolen Mills during November 13-14, 1984.

Parameter	Water		Sediment	
	Station 4 Clarifier (Final Effluent) 24-hr. Composite (ug/L)	Field Blank (ug/Kg)	Station 5 Return Activated Sludge Grab (ug/Kg)	Station 7 Upper Creek Pond Grab (ug/Kg)
Base/Neutral Compounds				
dichlorobenzene, 1,2	0.1u	0.1u	1,600u	11,000
dichlorobenzene, 1,4	0.1u	0.1u	1,600u	220
naphthalene	0.1u	0.35	1,600u	13,000
chrysene	0.1u	0.1u	1,600u	110m
Acid Compounds				
phenol, 2,4-dimethyl	0.1u	0.1u	1,600u	660
phenol	0.1u	0.1u	1,600u	240
4-methylphenol	0.1u	0.1u	140,000	1,400
naphthalene, 2 methyl	0.1u	0.3	1,600u	33,000
Pesticides				
4-4'-DDT	0.003u	*	150	504
4-4'-DDE	0.003u	*	18u	36
4-4'-DDD	0.003u	*	18u	49
gamma-BHC	0.003u	*	420	10u
PCBs				
PCB 1260	0.003u	*	1,860	10u
Tentatively Identified Compounds				
benzene, (1-methyl-ethyl)	ND	ND	ND	10,000
trisulfide, dimethyl-	ND	ND	ND	15,000
benzene, 1,2,3(or isomer)-trimethyl-	ND	ND	ND	9,800
ethanone, 1-(3-methyl-phenyl)-	ND	ND	ND	4,500
benzene, 1,2,3,4-tetramethyl-	ND	ND	ND	4,400
1H-indene-2,3-dihydro-4-methyl	ND	ND	ND	3,800
benzene, 1-ethyl-3-(1-methylethyl)-	ND	ND	ND	3,000
1H-indene,2,3-dihydro-1,6-dimethyl	ND	ND	ND	9,100
naphthalene, 1-methyl-	ND	0.5	ND	86,000
1,1'-biphenyl	ND	ND	ND	5,100
naphthalene, 2-ethyl-	ND	ND	ND	11,000
naphthalene,2,3-dimethyl	ND	ND	ND	23,000
naphthalene,1,4-dimethyl	ND	ND	ND	13,000
naphthalene,1,2-dimethyl	ND	ND	ND	3,900
phenol,2,6-bis(1,1-dimethylethyl)-4-methyl-,methylcarbamate	ND	ND	ND	63,000
naphthalene,1,4,6-trimethyl-	ND	ND	ND	5,400
phenol,4-(2,2,3,3-tetramethylbutyl)	ND	ND	ND	61,000
phenol,4-(1,1,3,3-tetramethylbutyl)-	ND	ND	ND	66,000
benzene,1-methyl-3-(1-methylethyl)-	ND	ND	ND	ND
phosphoric acid, diethyl ester	ND	2.4	ND	ND
Percent Solids	--	--	3.03	14.34

u = value is less than level of detection
ND = none detected
m = value is greater than detection limit but less than level of quantification
* = this analysis not performed on field blank

Memo to Jon Neel
Pendleton Woolen Mills Wastewater Treatment Plant Class II Inspection,
September 25-26 and November 13-14, 1984

Ninety-Six-Hour Bioassays (Salmonid)

The final effluent appeared to contain a toxic component during the September survey, but was not toxic during the follow-up survey in December. An effluent with periodic toxicity is indicated. Zinc may have been a major factor in the September 25-26 bioassay mortalities since the concentration exceeded the not-to-exceed anytime criteria of 163 ug/L by a considerable margin. Copper, chromium, and lead also exceeded respective criteria. Chromium was considered to be primarily in the trivalent form based on field analyses.

The return activated sludge was moderately toxic during both surveys (Table 14).

Table 14. 96-hour bioassay results, Pendleton Woolen Mills, September 24-25 and November 13-14, 1984.*

Sample Type	Date	Sample Dilution	Live	Dead	Percent Mortality
Clarifier Effluent - Station 4	9/25-26	65% effluent	0	30	100
	9/25-25	Control	30	0	0
	12/13-14	65% effluent	30	0	0
	12/13-14	Control	30	0	0
Return Activated Sludge - Station 5	9/25-26	1:1000 (1000 mg/L)	27	3	10
	9/25-26	Control	30	0	0
	12/13-14	1:100 (100 mg/L)	23	9	30
	12/13-14	Control	30	0	0

*Test organisms were juvenile rainbow trout (Salmo gairdneri) in all cases.

LABORATORY PROCEDURES REVIEW

The Laboratory Procedural Survey form completed during the inspection is included in Appendix I. A summary of the findings follows:

1. Sampling Methods. The composite samplers in use at the time of the inspection were antiquated and unable to collect reliable information. Since that time, two new units have been purchased which should resolve most of the problems. Samples collected in the future must be refrigerated from the time collected until the analyses are performed. As previously stated, the difficulty of obtaining a representative sample from the ballast pond can be minimized by drawing samples at short time intervals, 5 to 10 minutes.

2. Biochemical Oxygen Demand. A Hach Manometric BOD Apparatus, Model 2173 was being used. This is not an approved method. BOD analyses must be performed using equipment and methods described in Standard Methods (APHA-AWWA-WPCF, 1980). Don Wienk was given a copy of the WDOE guidelines for laboratory procedures for reference (WDOE, 1977). The Pendleton laboratory has purchased the required analytical equipment for this test.

3. Total Suspended Solids. The procedures review did not identify any problems with this test.

The results of the samples split between the WDOE and Pendleton laboratories are given in Table 15. The results compared fairly well. The ballast pond effluent BOD and COD differed markedly with no reason apparent.

Table 15. Comparison of samples split between the WDOE and Pendleton laboratories; September 25-26, 1984.

Parameter	Ballast Pond Influent		Ballast Pond Effluent		Clarifier (final) Effluent	
	WDOE	Pendleton	WDOE	Pendleton	WDOE	Pendleton
BOD (mg/L)*	210	197	68	154	<10	13
COD (mg/L)*	270	360	320	703	240	125
TSS (mg/L)*	80	54	57	64	59	59
pH (S.U.)**	7.0	7.0	7.1	6.9	7.4	7.4
Phenol (mg/L)**	--	--	--	--	0.05	0.04
Sulfide (mg/L)**	--	--	--	--	<0.1	0.03
Chromium (mg/L)**	--	--	--	--	0.5	0.30

*Composite
**Grab

SUMMARY AND DISCUSSION

It was evident during the inspection that the wastewaters generated by Pendleton Woolen Mills are highly variable in composition and strength. This characteristic carries through to the final effluent which at times contains a toxic component. Metals are a problem. Receiving water data suggest that organic toxicants may periodically be a concern. The fact that the treatment system has experienced more than one upset during the last year further suggests toxicity problems.

The single most important operational change recommended is that the treatment plant obtain basic monitoring data which accurately reflect the characteristics

of the waste streams as they enter and pass through the system, including during periods of slug loading. Very little reliable information currently exists. Process control options cannot be adequately evaluated until a baseline of these data is collected. The sampling should cover several months in order to reflect various production levels and product mixes. The basic methods for performing an effective waste survey at textile mills are outlined in the EPA publication entitled "Environmental Pollution Control, Textile Processing Industry" (EPA, 1978). A copy of this document should be obtained by Pendleton if one is not already on hand.

In the near future, the treatment plant should have the monitoring and analytical equipment required for an effective monitoring program. A WDOE quality assurance review should be performed after this equipment is obtained.

Copper and zinc were high enough to inhibit nitrification, although problems of this nature were not noted. Investigations should be performed to further evaluate the possibility of inhibition of both carbonaceous and nitrification processes when toxics are present in the system. There is also the possibility that denitrification was occurring at the time of the inspection. Both nitrate and ammonia were very low in the final effluent.

The fact that the treatment plant periodically experiences toxic conditions makes any BOD results suspect since such conditions can inhibit this test. Consideration should be given to this problem when BOD tests are performed.

The ballast pond has been upgraded since this inspection was performed. At the request of the WDOE Southwest Regional Office, the pond has been dredged to increase detention time. A surface aerator has been installed to improve circulation and the effluent pump house now has a pH alarm. At the time of the inspection, a mechanically cleaned bar rack was being constructed at the influent channel to aid in removing debris, mainly wool fibers. The unit is now operating. These actions should result in a well-mixed influent, but probably will not resolve the problems caused by slug loading and flow fluctuations.

The pond and unnamed creek affected by runoff from the mill grounds are seriously polluted. Remedial action may be required. Further investigation of this problem is needed.

JB:cp

Attachments

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APPENDIX

LABORATORY PROCEDURAL SURVEY

Discharger: Pendleton Woolen Mill

NPDES Permit Number: _____

Date: 9/26/84

Industrial/Municipal Representatives Present: _____

Agency Representatives Present: Don Wienk (Asst. chemist), John Bernhardt

I. COMPOSITE SAMPLES

A. Collection and Handling

last week influent compositor broke. Effluent now works. New Isco compositors ordered →

1. Are samples collected via automatic or manual compositing method? both, Model? _____

a. If automatic, are samplers portable _____ or permanently installed ✓?

This new influent one will be sequential and effluent total composite. →

Comments/problems _____

2. What is the frequency of collecting composite samples? Twice per week, normally. Daily for last 3 mo.

3. Are composites collected at a location where homogeneous conditions exist?

alkaline (high pH) finishing water (soaps, etc) stay on top. Acid dye waters stay on bottom. Generally drawn from bottom when stratified ←

a. Influent? No. at outlet of ballast pond. Have a problem in that ballast pond stratified.

b. Final Effluent? yes

c. Other (specify)? _____

4. What is the time span for compositing period? 1 hour

small timed pump set to 4 sec./hours which est. → 2 ~250 ml.

Sample aliquot? ~250 ml 4 sec. or pump. mls per _____ minutes

5. Is composite sample flow or time proportional? Time

6. Is final effluent composite collected from a chlorinated or non-chlorinated source? Non-chlorinated

7. Are composites refrigerated during collection? No

8. How long are samples held prior to analyses? about two hours.

9. Under what condition are samples held prior to analyses?

   a. Refrigeration? _____

   b. Frozen? _____

   c. Other (specify)? held at room temperature

10. What is the approximate sample temperature at the time of analysis? Approx. 21°C varies a little

11. Are compositor bottles and sampling lines cleaned periodically? Buckets periodically, lines no:

   a. Frequency? daily

   b. Method? Scrub brush & wipe by hand

12. Does compositor have a flushing cycle? No influent yes. effluent (new ones will)

   a. Before drawing sample? 1 minute or two.

   b. After drawing sample? 30 sec.

13. Is composite sample thoroughly mixed immediately prior to withdrawing sample? yes.

Recommendations:

Refrigerate compositors (new ones will do this)

II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

A. Technique

1. What analysis technique is utilized in determining BOD_5?

   a. Standard Methods? _____ Edition? _____

   b. EPA? _____

   c. A.S.T.M.? _____

   d. Other (specify)? Hach Manometric BOD Apparatus Model 2173

B. Seed Material

1. Is seed material used in determining BOD? No

2. Where is seed material obtained? NA

3. How long is a batch of seed kept? NA

   and under what conditions? (temperature, dark) _____

4. How is seed material prepared for use in the BOD test? NA

Recommendations:

Won't be using Manometric procedure any longer. Asking if can go to Tech Line Instruments B.O.D. Tester Model No. 026-~~0~~102 Telephone 1-800-328-7518. Address: Techline Instruments, P.O. Box 1236, Fond du Lac, Wisconsin 54935. Salesman - said can use if correlated with type of wastewater tested. Question to us - is this OK. Check on seed requirements. Noted that probably will have to go with Standard Methods Approved Techniques. Will get back

Note will be purchasing a Aire-O_2 aeration system (2 Hp) for ballast pond to mix. Eliminated stratification.

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? _____ } Don't do any dilution
   b. Deionized? _____ }

   c. Tap _____, chlorinated _____ non-chlorinated _____

   d. Other (specify)? _____

2. Is reagent water aged prior to use? NA.

   How long? _____, under what conditions? _____

   _____

Recommendations:

Again will check out test they would like to use, but probably go with Standard Methods. Left copy of WDOE publication "Lab. procedures ... BOD ... 1977.

D. Dilution Water - Don't currently use any

1. Are the four (4) nutrient buffers added to the reagent water?

   _____

   a. _____ mls of each nutrient buffer per _____ mls of reagent water

2. When is phosphate buffer added (in relation to setting up BOD test)? _____

3. How often is dilution water prepared? _____
   Maximum age of dilution water at the time test is set up.

   _____

4. Under what conditions is dilution water kept? _____

   _____

5. What is temperature of dilution water at time of setup? _____

Recommendations:

their existing unit is maintained at 20° F.

E. Test Procedure

1. How often are BOD's being set up? once per week

   What is maximum holding time of sample subsequent to end of composite period? three hours

2. If sample to be tested has been previously frozen, is it reseeded? _____ How? Not frozen

3. Does sample to be tested contain residual chlorine? No
   If yes, is sample

   a. Dechlorinated? _____

      How? _____

   b. Reseeded? _____

      How? _____

4. Is pH of sample between 6.5 and 8.0? influent not necessarily effluent yes.

   If no, is sample pH adjusted and sample reseeded? No

5. How is pH measured? Corning Model 7

   a. Frequency of calibration? Once per week

   b. Buffers used? Use 4, 7, 10 buffers

6. Is final effluent sample toxic? No it is not. Could be debated.

7. Is the five (5) day DO depletion of the dilution water (blank) determined? No dilutions, normal range? _____

8. What is the range of initial (zero day) DO in dilution water blank? No dilutions

9. How much seed is used in preparing the seeded dilution water? NO seed

10. Is five (5) day DO depletion of seeded blank determined? No
If yes, is five (5) day DO depletion of seeded blank approximately 0.5 mg/l greater than that of the dilution water blank?
_____

11. Is BOD of seed determined? No

12. Does BOD calculation account for five (5) day DO depletion of

a. Seeded dilution water? No

How? _____

b. Dilution water blank? No

How? _____

13. In calculating the five (5) day DO depletion of the sample dilution, is the initial (zero day) DO obtained from

a. Sample dilution? No dilutions

b. Dilution water blank? _____

14. How is the BOD_5 calculated for a given sample dilution which has resulted in a five (5) day DO depletion of less than 2.0 ppm or has a residual (final) DO of less than 1.0 ppm? NA

_____

_____

15. Is liter dilution method or bottle dilution method utilized in preparation of

a. Seeded dilution water? NA

b. Sample dilutions? NA

16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? they hold 5 days @ 70° F

17. How is incubator temperature regulated? Hach Refrigerator Control Unit 69° when checked.

18. Is the incubator temperature gage checked for accuracy? No

    a. If yes, how? _____

    b. Frequency? _____

19. Is a log of recorded incubator temperatures maintained? No

    a. If yes, how often is the incubator temperature monitored/ checked? _____

20. By what method are dissolved oxygen concentrations determined?

    Probe _____ Winkler _____ Other Not done

    a. If by probe:

        1. What method of calibration is in use? _____

        2. What is the frequency of calibration? _____

    b. If by Winkler:

        1. Is sodium thiosulfate or PAO used as titrant? _____

        2. How is standardization of titrant accomplished? _____

        3. What is the frequency of standardization? _____

Recommendations:

F. Calculating Final Biochemical Oxygen Demand Values Washington State Department of Ecology

1. Correction Factors

a. Dilution factor:

$$= \frac{\text{total dilution volume (ml)}}{\text{volume of sample diluted (ml)}}$$

b. Seed correction:

$$= \frac{(\text{BOD of Seed})(\text{ml of seed in 1 liter dilution water})}{1000}$$

c. F factor ∿ a minor correction for the amount of seed in the seeded reagent versus the amount of seed in the sample dilution:

$$F = \frac{[\text{total dilution volume (ml)}] - [\text{volume of sample diluted ml}]}{\text{Total dilution volume, ml}}$$

2. Final BOD Calculations

a. For seed reagent:

(seed reagent depletion-dilution water blank depletion) x D.F.

b. For seeded sample:

(sample dilution depletion-dilution water blank depletion-scf) x D.F.

c. For unseeded sample:

(sample dilution depletion-dilution water blank depletion) x D.F.

3. Industry/Municipality Final Calculations

Method used – Put straight "effluent" at 157 ml dose. Creates vacuum. Draws Hg up. Units given in ppm after 5 days.

Recommendations:

_____

_____

_____

_____

_____

_____

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

1. What analysis technique is utilized in determining total suspended solids?

   a. Standard Methods? ✓ Edition 13th

   b. EPA? _____

   c. A.S.T.M.? _____

   d. Other (specify)? Gravimetric analysis

B. Test Procedure

1. What type of filter paper is utilized:

   a. Reeve Angel 934 AH? _____

   b. Gelman A/E? _____

   c. Other (specify)? Whatman GF/C ← designated most often

   d. Size? _____

use 5.5 cm filter paper for effluent
use 9.0 cm filter paper for aeration basin

2. What type of filtering apparatus is used? Doerr – Vacuum pump. Gast Manufacturing Model 0211-V36A, 1/6 Hp
   Broke down now. Been using aspirator

3. Are filter papers prewashed prior to analysis? No

   a. If yes, are filters then dried for a minimum of one hour 2 hr. at 103°C-105°C 103° C?

   b. Are filters allowed to cool in a dessicator prior to weighing? yes.

4. How are filters stored prior to use? in desiccator until weigh, then use.

5. What is the average and minimum volume filtered? 100 ml Ave. always.

6. How is sample volume selected?

   a. Ease of filtration? ✓

   b. Ease of calculation? ✓

   c. Grams per unit surface area? _____

   d. Other (specify)? Taken as norm matter of convenience

7. What is the average filtering time (assume sample is from final effluent)? 6 seconds.

8. How does analyst proceed with the test when the filter clogs at partial filtration? No problem on final effluent, ~~let~~

   (1) If anticipate problem, let settle, decant, then filter residue + some liquid

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? always 100 ml.

   only time vary use 25 ml. sludge. Don't normally duplicate. —>

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? No

    (1) Decant off liquid
    (2) run liquid through filter
    (3) run residue through filter
    (4) rinse sides of aeration basin sample but not the effluent or influent

11. Is filter funnel washed down following sample filtration? yes

12. Following filtration, is filter dryed for one (1) hour, cooled in a desscator, and then reweighed? yes

13. Subsequent to initial reweighing of the filter, is the drying cycle repeated until a constant filter weight is obtained or until weight loss is less than 0.5 mg? No

14. Is a filter aid such as cellite used? No.

a. If yes, explain: _____

Recommendations:

Will check out and get back to.

C. Calculating Total Suspended Solids Values Washington State Department of Ecology

yes → A. $mg/l\ TSS = \frac{A-B}{C} \times 10^6$

1. Where: A = final weight of filter and residue (grams)

B = initial weight of filter (grams)

C = Milliliters of sample filtered

2. Industry/Municipality Calculations

Recommendations:

SPLIT SAMPLE RESULTS:

Origin of Sample _____

Collection Date _____

BOD		TSS		EPA BOD Standard	
DOE	IND./MUN.	DOE	IND./MUN.	DOE	IND./MUN
___	_____	___	_____	___	_____

Starting Monday is taking Wastewater operators course at Clackamas CC. 4 year course.

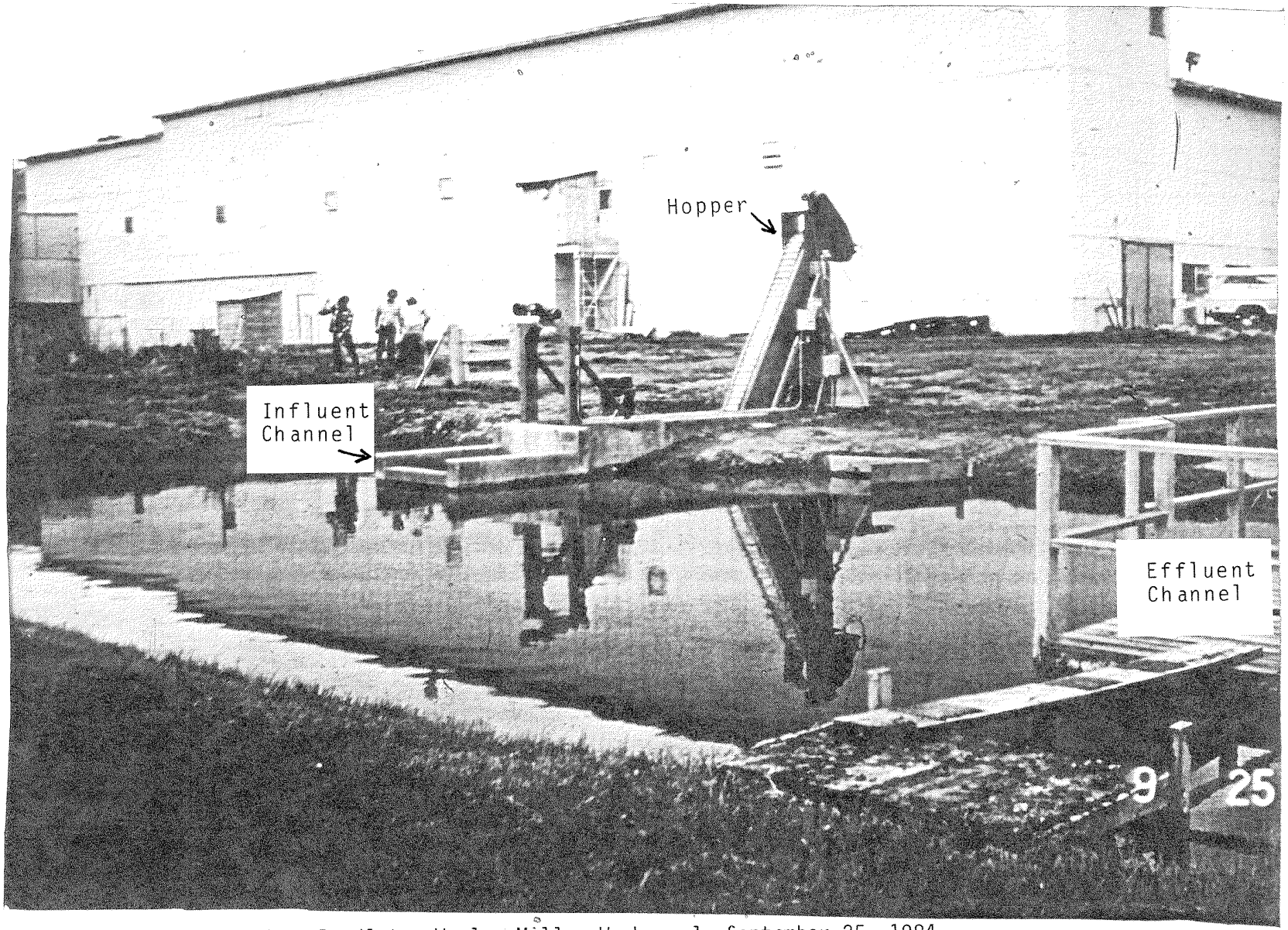

Plate 1. Ballast pond at Pendleton Woolen Mills, Washougal, September 25, 1984.

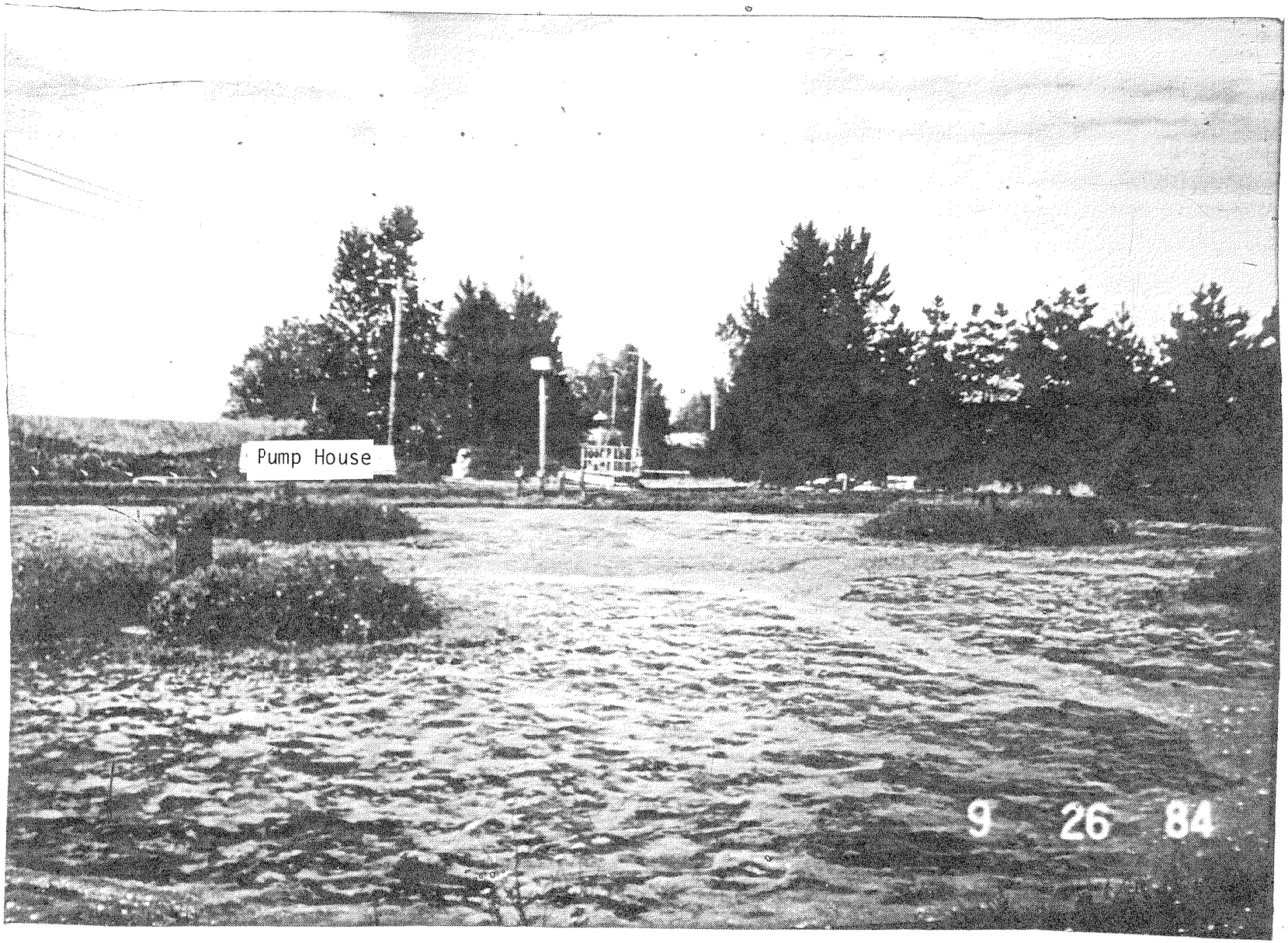

Plate 2. Aeration basin at Pendleton Wooler Mills, Washougal, September 26, 1984.

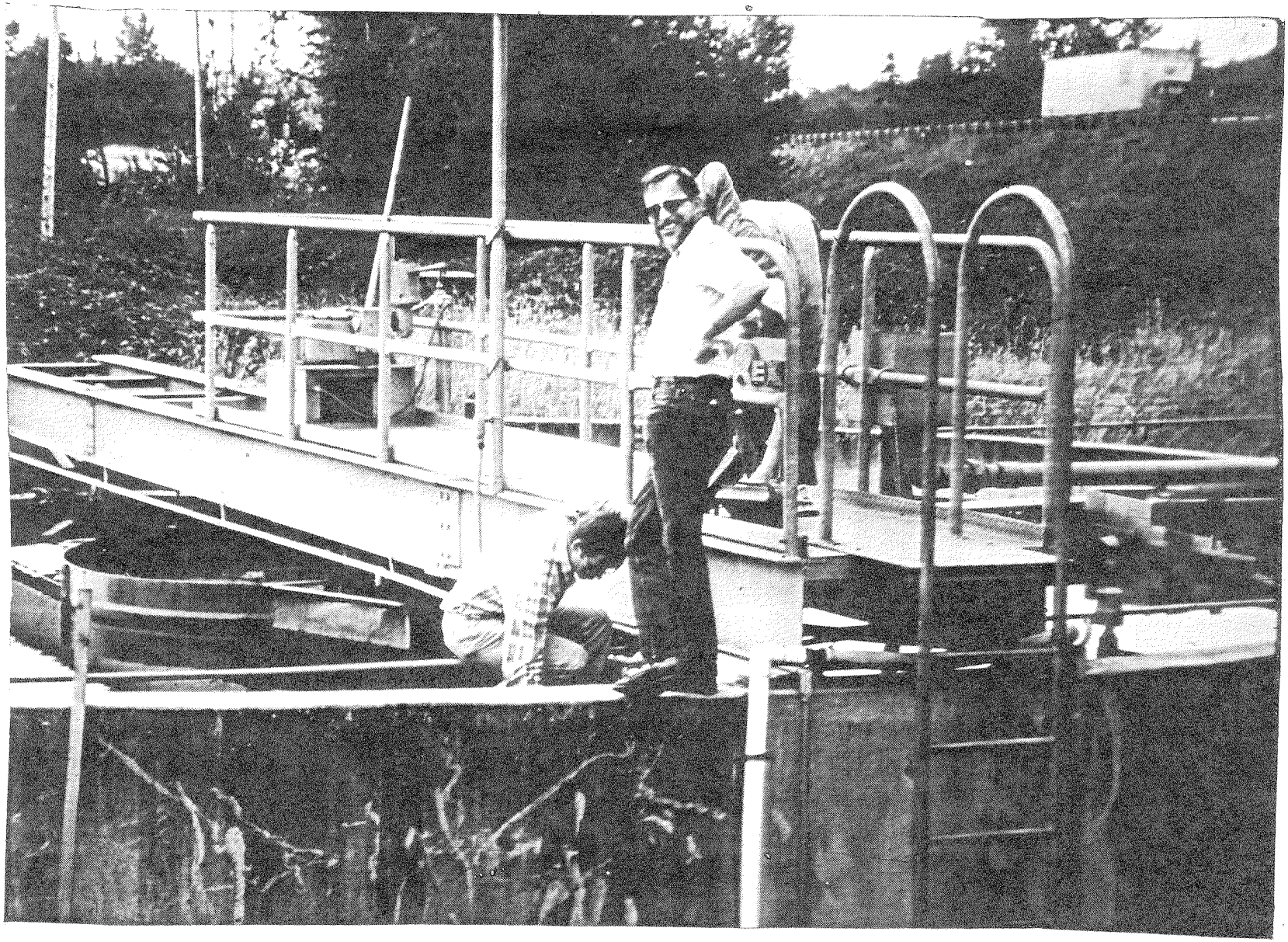

Plate 3. Clarifier at Pendleton Woolen Mills, Washougal, September 26, 1984.